Measurement of activation cross sections producing short-lived nuclei with pulsed neutron beam

Toshiaki Shimizu[1], Kazumasa Arakita[1], Itaru Miyazaki[1], Michihiro Shibata[1], Kiyoshi Kawade[1], Kentaro Ochiai[2], Takeo Nishitani[2]

[1] *Department of Energy Engineering and Science, Nagoya University*
[2] *Department of Fusion Engineering Research, Naka Fusion Research Establishment, Japan Atomic Energy Research Institute*

We measured activation cross sections producing short-lived nuclei with half-lives of less than 10 seconds, which had few experimental reports, by using pulsed d-D neutron beam.

It is difficult for in-beam measurement to measure weak gamma rays owing to high background by prompt gamma rays. Pulsed neutron beam can avoid the influence of prompt gamma rays.

For efficiently measurements of the induced gamma ray of interest, each position of a neutron source, a High Purity Germanium (HPGe) detector, and a sample was needed to optimize. The distance between the neutron source and the HPGe detector has a limitation from the viewpoint of shielded form neutrons. The minimum distance, which could accept the neutron damage of detector, was estimated by using the Monte-Carlo simulation code MCNP4C.

The d-D neutrons were generated by bombarding a water-cooled deuterated titanium target with 350 keV d^+-beams at the 80-degree beam line of the Fusion Neutronics Source at the Japan Atomic Energy Research Institute. The durations of irradiation and measurement were chose to be the same, which was about two half-lives of the induced activity of interest. Samples were located at angles of 0 and 90 degree with respect to the d^+-beam that energy of neutron was 3.09 and 2.54 MeV, respectively.

The cross section data of 4 (n, n') reactions (^{90}Zr, ^{183}W, ^{197}Au, and ^{207}Pb) with half-lives between 0.8 and 7.8 seconds were obtained. For check the measuring method, the cross section of ^{197}Au (n, n') ^{197m}Au reaction was obtained with a pneumatic sample transport system. We concluded that activation cross sections could be measured down to about 100 mb with pulsed neutron in the energy range of 2 to 3 MeV.

In the future, we will measure activation cross sections using pulsed d-T neutron beam.

Email: t-shimizu@ees.nagoya-u.ac.jp